

# A windshield washer concentrate and the use thereof

**Kegnæs, Søren; Hansen, Casper Lykke; Le Quement, Sebastian Thordal**

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(71) Applicant: **DANMARKS TEKNISKE UNIVERSITET** [DK/DK]; Anker Engelunds Vej 101 A, 2800 Lyngby (DK).

(72) Inventors: **KEGNÆS, Søren**; Hammars Parkväg 7, 21630 Limhamn (SE). **HANSEN, Casper Lykke**; Houmanns Allé 3, 3.tv., 2400 Copenhagen NV (DK). **LE QUEMENT, Sebastian Thordal**; Lynneborggade 25, 1.tv., 2300 Copenhagen S (DK).

(74) Agent: **PLOUGMANN VINGTOFT A/S**; Rued Langgaards Vej 8, 2300 Copenhagen S (DK).

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(57) Abstract: The present invention relates to awindshield washerconcentratecomprising a first compoundand alcohol, wherein said first compound is ammonium acetateor ammonium formateor a combination thereof, and whereinthe concentrate comprises the first compound in an amount of at least 5g per litre alcohol.

# A windshield washer concentrate and the use thereof

## Technical field of the invention

The present invention relates to a windshield washer concentrate comprising a first compound and alcohol, wherein the first compound is ammonium acetate or ammonium formate or a combination thereof, and wherein the the concentrate comprises the first compound in an amount of at least 5 g per litre alcohol.

## Background of the invention

The use of windshield washers worldwide is enormous; In Denmark alone, it is estimated that about 18 million litres of windshield washer is used every year.

The typical windshield washer used today is ready to use liquid compositions comprising two compounds, namely a "small" alcohol and water. These ready to use windshield washers are stored and sold whereafter they are poured into the windshield washer tank of a car. By "small alcohol" is meant an alcohol with 1 to 5 carbon atoms. An example of a typical windshield washer is 25-50% alcohol and water added up to 100%. Ethanol is the most commonly used alcohol for windshield washers. Other components than alcohol and water, which may possibly be present in a liquid windshield washer as known today, are soap, fragrances, bitter substances and colourings. Liquid windshield washers with a lower amount of alcohol, such as below 15% alcohol, are known today. However, the freezing point of such products is lower because of the less amount of alcohol present.

Liquid windshield washers take up a lot of space both under transportation and storage. Therefore, the storage and transport expenses with the currently known windshield washers are high.

In colder climates, it is a demand from users that windshield washers are freeze resistant at low temperatures, such as minus temperatures below minus 5 degrees and preferably even at lower temperatures, such that the windshield

washer can be used in frosty weather, which typically is from November to February. Windshield washers should not freeze or form brash ice in cold weather, because the nozzle in the sprinkler system will then be blocked and in worse case frost damages may occur.

Hence, a windshield washer concentrate being freeze resistant at low temperatures would be advantageous.

Hence, there is a need for a windshield washer concentrate which limit the storage and transport expenses and which when diltuted is freeze resistant in frosty weather and freeze resitant at even lower temperatures than windshield washer solutions known today comprising alcohol and water.

**Summary of the invention**

Thus, an object of the present invention relates to providing a windshield washer concentrate that solves the above mentioned problems of the prior art.

In particular, it is an object of the present invention to provide a windshield washer concentrate which is freeze resistant at lower temperatures than the products used today.

A further object of the present invention is to provide a windshield washer concentrate which can be diluted in different mixing ratios, such that the user may obtain diffent windshield washer solutions with different freezing points.

The present invention also provides a windshield washer concentrate with which the expenses to transport, storage and other logistics are reduced as compared to when using ready to use water based windshield washer solutions. As a consequence hereof, the windshield washer concentrate also provides environmental savings in form of for example less $CO_2$ emission, since transportation and other logistics of the product are reduced.

Thus, one aspect of the invention relates to a windshield washer concentrate comprising a first compound and alcohol, wherein the first compound is ammonium acetate or ammonium formate or a combination thereof, and wherein the concentrate comprises the first compound in an amount of at least 5 g per litre alcohol.

Another aspect of the present invention is to provide a ready-to-use windshield washer solution comprising the windshield washer concentrate according to the present invention and water.

Yet another aspect of the present invention is the use of the windshield washer concentrate according to the present invention for preparing a ready-to-use windshield washer solution, wherein the windshield washer concentrate is mixed with water.

The present invention will now be described in more detail in the following.

**Detailed description of the invention**

Definitions:

Prior to discussing the present invention in further details, the following terms and conventions will first be defined:

In the context of the present invention, mentioned percentages are weight/weight percentages unless otherwise stated.

The term "and/or" used in the context of the "X and/or Y" should be interpreted as "X", or "Y", or "X and Y".

In the context of the present application, a ratio 1:1 between to compounds "X" and "Y" is defined as a composition comprising 1 part "X" and 1 part "Y". For example a ratio 1:5 between "X" and "Y" means 1 parts "X" and 10 part "Y". By the term "part" is meant the unit measured, for example weight, volume, etc.

Numerical ranges as used herein are intended to include every number and subset of numbers contained within that range, whether specifically disclosed or not. Further, these numerical ranges should be construed as providing support for a claim directed to any number or subset of numbers in that range. For example, a disclosure of from 1 to 10 should be construed as supporting a range of from 1 to 8, from 3 to 7, from 4 to 9, from 3.6 to 4.6, from 3.5 to 9.9, and so forth.

In the context of the present application, the term "freeze resistant" refers to a solution which at a given temperature does not freeze, i.e. make ice crystal, and does not form a precipitate. When a solution is freeze resistant at a given temperature, it means that the solution is still in a liquid state, no ice crystals has been formed, such as no brash ice or slush ice, and no precipitate has been formed in the solution. In the context of the present invention, "freeze resistant" is not to be compared with "melting" or "melting point". The melting point is the temperature when a compound in solid state begins to melt to a liquid state. Freezing point is when the liquid solution begins to make ice crystals and thus becomes a solid. The melting point and freezing point may be different from each other.

The term "antifreeze" does similar to "freeze resistant" refer to a condition where a concentrate when diluted in water has not yet begun to freeze, i.e. not yet begun to create ice crystals, and no precipitate has been formed. The terms "antifreeze" and "freeze resistant" are used interchangeably.

Contrary to "freeze resistant" and "antifreeze", the term "freeze" refers to when a solution is partly or fully frozen, i.e. ice crystals have been formed in the solution or precipitate has been formed in the solution.

All references to singular characteristics or limitations of the present invention shall include the corresponding plural characteristic or limitation, and vice versa, unless otherwise specified or clearly implied to the contrary by the context in which the references is made.

Unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art.

**Windshield washer concentrate**

The invention in one aspect relates to a windshield washer concentrate comprising a first compound and alcohol, wherein the first compound is ammonium acetate or ammonium formate or a combination thereof, and wherein the concentrate comprises the first compound in an amount of at least 5 g per litre alcohol.

The windshield washer concentrate may be prepared in doses having a predefined size. The size of the concentrate dose is not limited to any particular size, but may be any size. The size is dependent on the amount of ready to use liquid solution which is wished to be prepared.

For example the concentrate could be in a size of 500 ml and said concentrate could before use for example be diluted in 2.5 L water.

Furthermore, the windshield washer concentrate may be used as a windshield washer directly and undiluted. When the concentrate is used undiluted as it is, the freezing point may be as low as minus 70 °C. When diluted, the windshield washer will have a higher freezing point temperature, the more diluted the concentrate is. For example a concentrate according to the invention comprising 820 mg ammonium acetate, 400 mg ammonium formate, 2.54 ml ethylene glycol and 6.98 ml ethanol will undiluted have a freezing point of about minus 63 °C, while the same concentrate diluted with water 1:1 will have a freezing point of about minus 49 °C. The concentrate diluted in a mixing ratio of 1:2 between concentrate and water will result in a freezing point of about minus 26 °C, while a concentrate mixed with water in a ratio of 1:4 will result in a freezing point of about minus 12 °C. Thus, different windshield washer solutions can be obtained from the concentrate depending of which freezing point is wished, i.e. the concentrate are suitable for use in different types of wheather and down to very cold climates.

The windshield washer concentrate according to the present invention comprises a first compound.

The first compound according to the present invention is ammonium acetate or ammonium formate or a combination thereof Ammonium acetate and ammonium

formate have been shown to have a good solubility in both alcohol and water and have surprisingly been shown to have a synergistic effect with alcohols in depressing the freezing point. Furthermore, ammonium formate evaporates completely as ammonia and formic acid, while ammonium acetate evaporates as ammonia and acetic acid. Thus, ammonium formate and/or ammonium acetate will when used in a windshield washer not precipite and cause deposits on the windshield of a car. Furthermore, ammonium formate and/or ammonium acetateare highly soluble in water.

Other ammonium salts such as for example ammonium hydroxide are not suitable to use in a windshield washer, since ammonium hydroxide are highly alkaline and corrosive against the metal and rubber bands on vehicles. In addition, ammonium hydroxide will form ammonia, which will evaporate when the windshield washer tank is opened which is unpleasant and un healthy for the user. Further, ammonium hydroxide will not be as effective in decreasing the freezing point as ammonium acetate and ammonium formate. Thus, the concentrate according to the invention does in a preferred embodiment not include ammonium hydroxide. Ammonium hydroxide is wished avoided in the concentrate according to the invention.

Other ammonium salts such as ammonium carbonate and ammonium bicarbonate is also less usefull in windshield washers than ammonium formate and ammonium acetate, since ammonium carbonate and ammonium bicarbonate is less soluble in water and tend to precipitate over time when dissoluble in water. Precipitation is wished avoided with the present windshield washer concentrate.

Other salts are known to decrease the freezing point of water, such as sodium and potassium salts. However, such salts are also wished avoided since they easily precipitates under use and have a corrosive effect.

It has surprisingly been shown that concentrates comprising alcohol and a first compound is antifreeze resistant at lower temperatures than when the alcohol and one or more of the first compound is used alone.

In a preferred embodiment of the invention, the first compound is a combination of ammonium acetate and ammonium formate. It has surprisingly been shown that a combination of ammonium acetate and ammonium formate in a concentrate with alcohol will be freeze resistant at even lower temperatures than when ammonium acetate or ammonium formate is used alone with alcohol.

In an embodiment of the invention, the ratio between ammonium acetate and ammonium formate is in the range of 1:2 to 4:1, preferably 1:1 to 3:1, such as 1:1 to 2:1.

The inventors of the present invention has found out that the first compound according to the present invention is very effective in depressing the freezing point of water and therefore can be used in a windshield washer composition. Ammonium acetate and ammonium formate are also highly soluble in both alcohols and in water and are therefore particularly useful in a windshield washer concentrate having the benefit of taking up less space during storage and transportation. Further, solutions comprising the first compound in combination with alcohol will be freeze resistant at temperatures lower than if alcohol, ammonium acetate or ammonium formate is used alone. Further, the present inventors have found out that very small amounts of the first compound can be present in a concentrate with alcohol in order to obtain the synergistic freeze resistance at lower temperatures.

The inventors of the present invention have found out that a windshield washer concentrate comprising 5 g of the first compound dissolved in one litre of alcohol and said concentrate being diluted with water in a ratio of 1:5 will result in a lower freezing point than if the alcohol was used alone and diluted with water in a ratio of 1:5.

The more of the first compound being present in the concentrate, the lower the freeing point of the concentrate will be.

Thus, in an embodiment of the invention, the windshield washer concentrate comprises the first compound in an amount of at least 5 g per litre alcohol, such

as at least 10 g per litre alcohol, preferably 30 g per litre alcohol, even more preferably at least 40 g per litre alcohol, such as at least 50 g per litre alcohol.

In another embodiment of the invention, the windshield washer concentrate comprises from 5 to 590 g of a first compound per litre alcohol. For example the windshield washer concentrate may comprise from 20 to 400 g of the first compound per litre alcohol, such as from 30 to 300 g per litre alcohol, preferably from 40 to 250 g per litre alcohol.

The alcohol used according to the present invention may be one or more alcohols selected from alcohols having from 1-5 carbon atoms. Alcohols used may for example be methanol, ethanol, propanol, butanol, propylene glycol, 1,3-propanediol, ethylene glycol, diethylene glycol, glycerol or mixtures thereof.

Propylene glycol may also be termed as 1,2-propanediol.

Ethylene glycol may be also be termed as 1,2 ethanediol.

Propanol may be 1-propanol or 2-propanol and butanol may be 1-butanol, 2-butanol or *tert*-butanol.

Methanol has the lowest freezing point of the alcohols (see example 15). However, methanol is wished to be avoided in windshields washers since methanol unlike for instance ethanol is highly toxic. For example methanol is poisonous to the central nervous system, and may cause blindness, coma, and death in large amounts.

Therefore, in a preferred embodiment, the alcohol used according to the present invention is one or more alcohols selected from alcohols having form 2-5 carbon atoms. Most preferably, the alcohol is selected from the group of ethanol, propanol, propylene glycol, ethylene glycol or mixtures thereof.

In an embodiment of the invention, the alcohol is a combination of at least two alcohols. When two or more alcohols are used, the synergistic effect is obtained such that the freezing point becomes event lower than if the alcohols were used

alone. Preferably, the alcohol is a mixture of ethanol and at least one other alcohol and preferably the alcohol is a combination of ethanol and ethylene glycol. The alcohol may also be a combination of ethanol and diethylene glycol.

In an embodiment of the invention, at least 90% of the liquid in the windshield washer concentrate is alcohol. Such as at least 92%, preferably at least 95%.

The windshield washer concentrate according to the present invention may also comprise a soap. Without being bound by any theory, the inventors of the present invention believe that besides from providing a cleaning effect, the soap will also provide an improved antifreezing effect of the concentrate, i.e. the windshield washer concentrate comprising a first compound according to the present invention, alcohol and a soap will obtain a lower freezing point than a windshield washer concentrate comprising only the first compound and alcohol.

In an embodiment of the invention, the windshield washer concentrate comprises from 5 to 590 g of a first compound and from 0 to 50 g of a soap per litre alcohol. The soap may be any soap suitable for washing and cleaning, and in particular soaps suitable for windshield washing. The soap may for example be selected from the group of sulfonic acid sodium salts, such as sodium lauryl sulphate, sodium laureth sulphate, sodium C14-17 alkyl sulphonate (HOSTAPUR®SAS) or dodecylbenzenesulfonic acid sodium salt. Preferably, the soap is sodium lauruth sulphate and/or sodium C14-17 alkyl sulphonate.

The windshield washer concentrate may comprise further components such as colour agents, fragrances, bitter substance, softeners, surfactants or a mixture thereof.

In a particular embodiment, the windshield washer concentrate does not comprise water.

In an embodiment of the invention, the liquid in the concentrate is essentially consisting of alcohol. Some of the liquid may however also come from soap, colour agents, fragrances, softerners, bitter substances and surfactants.

A bitter substance may be denatonium benzoate and is added to avoid for example children to drink the concentrate or solutions based thereof.

**Use of the windshield washer concentrate**

The windshield washer concentrate may be used directly as a windshield washer without being diluted or the concentrate may be diluted with water to a windshield washer solution. The freezing point of the windshield washer solution will depend on the degree of dilution with water, the more the concentrate is diluted with water the higher the freezing point of the solution will be. Hence, the windshield washer concentrate according to the present invention may be used in preparing a ready-to-use windshield washer solution, i.e. the present invention relates to the use of the windshield washer concentrate according to the present invention for preparing a ready to use windshield washer solution wherein the windshield washer concentrate is mixed with water.

The mixing ratio between the windshield washer concentrate and water is preferably in the ratio of 1:10 to 2:1.

If the windshield washer concentrate is used to prepare a windshield washer solution intended to be used in colder climates, the mixing ratio between the concentrate and water is preferably in the range of 1:5 to 1:1, preferably in the range of 1:4 to 1:2.

If the windshield washer concentrate on the contrary is used in warmer climates or during summer periods then the concentrate may be diluted in higher mixing ratios, such as from 1:20 to 1:5, such as from 1:15 to 1:6, or from 1:10 to 1:7.

Thus, the windshield washer concentrate according to the present invention makes it possible for the user to mix the concentrate with water in a ratio which is dependent on the freezing point wished.

One advantage of the windshield washer concentrate according to the present invention is that it is easy and cheap to transport and store since it is in a concentrate form which may be diluted before use and therefore take up less space. Thus, transportation and storage facilities are reduced. Another advantage

that the windshield washer concentrate according to the present invention provides is the synergistic effect provided between alcohol and the first compound with regard to decreasing the freeze point, i.e. the combination of alcohol and the first compound results in a freezing point which is lower than the freezing point of the used alcohol and the first compound when used alone. There is a need for windshield washers with a low freezing point to be used during the winters in colder climates. No brash ice or precipitation is made with the windshield washer according to the present invention. A good cleaning effect is obtained. The windshield washer solution based on the diluted windshield washer concentrate does not enhance eroding or corroding of the surfaces of a car. Furthermore, rubber bands around glass surfaces of the car are not swelled by the composition of the invention.

The windshield washer concentrate according to the present invention may either be poured directly into the tank of a car and water added to the tank, such that the ready-to-use windshield washer solution is mixed directly in the tank of a car or the windshield washer concentrate and water is mixed outside the car and afterwards poured into the windshield washer tank of the car.

**Ready-to-use windshield washer solution:**

A further aspect of the invention relates to a ready-to-use windshield washer solution comprising the windshield washer concentrate according to the present invention and water.

The ready-to-use windshield washer solution according to the invention preferably comprises the windshield washer concentrate according to the invention and water in a ratio of from 1:10 to 2:1.

As mentioned above, the windshield washer concentrate according to the present invention makes it possible for the user to mix the concentrate with water in different ratios dependent on the freezing point wished.

If the windshield washer concentrate is used to prepare a windshield washer solution intended to be used in colder climates, the mixing ratio between the

concentrate and water is preferably in the range of 1:5 to 1:1, preferably in the range of 1:4 to 1:2.

If the windshield washer concentrate on the contrary is used in warmer climates or during summer periods then the concentrate may be diluted in higher mixing ratios, such as from 1:20 to 1:5, such as from 1:15 to 1:6, or from 1:10 to 1:7.

In the context of the present application, the term "at least" in the context of defining a ratio, e.g. 1:10, between "X" and "Y" mean that there may be at least 1 ml "X" and 10 ml "Y", such as for example there may be 5 ml "X" and still 10 ml "Y".

One of the benefits of the windshield washer concentrate according to the present invention is that the first compound such as ammonium acetate and/or ammonium formate is highly soluble at low temperatures (minus temperatures) and will not precipitate at low temperatures (minus temperatures). Further, the first compound(s) are in low concentrations able to provide a synergistically decreased antifreeze point in combination with alcohol as compared to when alcohol are used alone. Further, the windshield washer concentrate comprising alcohol and the first compound may be diluted more than 5 times in water and still provide a freezing point significantly lower than the freezing point of water. Thus, the amount of the first compound in the ready-to-use windshield washer solution may be at low as 0.8 g per litre solution in order to provide a reduced freezing point.

The ready-to-use windshield washer solution is easy to prepare since the windshield washer concentrate only needs addition of water before being used as a windshield washer.

The windshield washer concentrate according to the present invention both has a very good solubility at low temperatures, i.e. no precipitation occurs, and is highly effective in decreasing the freezing point. Thus, even when the windshield washer concentrate is mixed with water to prepare the ready-to-use windshield washer solution, in very small amounts, it will be freeze resistant at low temperatures and at temperatures below minus 8 degrees celcius.

It should be noted that embodiments and features described in the context of one of the aspects of the present invention also apply to the other aspects of the invention.

The invention will now be described in further details in the following non-limiting examples.

**Examples**

**Example 1 - Freezing tests of ammonium formate**

Freezing tests of ammonium formate in alcohol have been performed.

Samples with 10 ml of alcohol (3 ml ethylene glycol and 7 ml ethanol) was prepared and different amounts of ammonium formate was added to the 10 ml samples. 6 samples was prepared, each having different concentration of ammonium formate and each sample was diluted with 50 ml water.

Table 1 shows freezing tests of the 6 diluted samples and the amount of ammonium formate present in the concentrated 10 ml samples.

The 6 diluted samples with different concentrations of ammonium formate but the same concentration of alcohol (ethanol and ethylene glycol) were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 1: 3 ml ethylene glycol, 7 ml ethanol

| Amount ammonium formate | Freezing point |
|---|---|
| 0 mg | -7.4 °C |
| 50 mg | -7.5 °C |
| 100 mg | -7.8 °C |
| 200 mg | -8.0 °C |
| 300 mg | -8.1 °C |
| 500 mg | -8.6 °C |

Table 1 shows that the freezing point of a solution comprising alcohol and water (ratio 1:5) obtains an even lower freezing point if ammonium formate is added. Further, table 1 shows that amounts a low as 100 mg ammonium formate per 10 ml alcohol results a decreased freezing point.

**Example 2 - Freezing tests of ammonium acetate**

Freezing tests of ammonium acetate in alcohol have been performed.

Samples with 10 ml of alcohol (3 ml ethylene glycol and 7 ml ethanol) was prepared and different amounts of ammonium acetate was added to the 10 ml samples. 6 samples was prepared, each having different concentration of ammonium acetate and each sample was diluted with 50 ml water.

Table 2 shows freezing tests of the 6 diluted samples and the amount of ammonium acetate present in the concentrated 10 ml samples.

The 6 diluted samples with different concentrations of ammonium acetate but the same concentration of alcohol (ethanol and ethylene glycol) were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 2: 3 ml ethylene glycol, 7 ml ethanol

| Amount ammonium acetate | Freezing point |
|---|---|
| 0 mg | -7.4 °C |
| 50 mg | -7.6 °C |
| 100 mg | -7.7 °C |
| 200 mg | -8.3 °C |
| 300 mg | -8.6 °C |
| 500 mg | -8.9 °C |

Table 2 shows that the freezing point of a solution comprising alcohol and water (ratio 1:5) obtains an even lower freezing point if ammonium acetate is added.

Further, table 2 shows that amounts a low as 100 mg ammonium acetate per 10 ml alcohol results a decreased freezing point.

**Example 3 - Freezing tests of ammonium formate and ammonium acetate**

Freezing tests of samples comprising a mixture of ammonium acetate and ammonium formate in alcohol have been performed.
Samples with 10 ml of alcohol (3 ml ethylene glycol and 7 ml ethanol) was prepared and different amounts of ammonium formate and ammonium acetate was added to the 10 ml samples. 6 samples was prepared, each having different concentration of ammonium formate and ammonium acetate and each sample was diluted with 50 ml water.

Table 3 shows freezing tests of the 6 diluted samples and the amount of ammonium formate and ammonium acetate present in the concentrated 10 ml samples.

The 6 diluted samples with different concentrations of ammonium formate and ammonium acetate but the same concentration of alcohol (ethanol and ethylene glycol) were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 3: 3 ml ethylene glycol, 7 ml ethanol

| Amount ammonium acetate and ammonium formate | Freezing point |
|---|---|
| 0 mg + 0 mg | -7.4 °C |
| 25 mg + 25 mg | -7.8 °C |
| 50 mg + 50 mg | -8.0 °C |
| 100 mg + 100 mg | -8.4 °C |
| 150 mg + 150 mg | -8.7 °C |
| 250 mg + 250 mg | -9.2 °C |

Table 3 shows that the freezing point of a solution comprising alcohol and water (ratio 1:5) obtains an even lower freezing point if a mixture of ammonium acetetate and ammonium formate is added. Further, table 3 shows that amounts as low as 50 mg (25+25) ammonium acetate and ammonium formate per 10 ml alcohol results in a decreased freezing point. Further, the data shown in table 3 shows that a combination of ammonium acetate and ammonium formate results in a lower freezing point as compared to when ammonium acetate and ammonium formate is used alone.

**Example 4 - Freezing tests of ammonium acetate in a concentrate comprising a fixed amount of ammonium formate, ethanol and ethylene glycol**

Freezing tests of samples comprising a different amount of ammonium acetate in a concentrate with a fixed amount of ammonium formate, ethanol and ethylene glycol have been performed.

Samples with 2.54 ml ethylene glycol and 6.98 ml ethanol was prepared and 400 mg ammonium formate was added. Different amounts of ammonium acetate was added to the samples. 5 samples was prepared, each having different concentration of ammonium acetate and each sample was diluted with 50 ml water.

Table 4 shows freezing tests of the 5 diluted samples and the amount of ammonium acetate present in the concentrated samples.

The 5 diluted samples with different concentrations of ammonium acetate but the same concentration of alcohol (ethanol and ethylene glycol) were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 4: 400 mg ammonium formate, 2.54 ml ethylene glycol, 6.98 ml ethanol

| Amount ammonium acetate | Freezing point |
|---|---|
| 0 mg | -7.6 °C |
| 300 mg | -8.2 °C |
| 600 mg | -8.3 °C |
| 900 mg | -8.8 °C |
| 1200 mg | -9.4 °C |

Table 4 shows that the freezing point of a solution comprising ammonium formate, alcohol and water (ratio 1:5) obtains an even lower freezing point if ammonium acetetate is added.

**Example 5 - Freezing tests of ammonium formate in concentrate comprising fixed amount of ammonium acetate, ethanol and ethylene glycol**

Freezing tests of samples comprising a different amount of ammonium formate in a concentrate with a fixed amount of ammonium acetate, ethanol and ethylene glycol have been performed.

Samples with 2.54 ml ethylene glycol and 6.98 ml ethanol was prepared and 820 mg ammonium acetate was added. Different amounts of ammonium formate was added to the samples. 6 samples was prepared, each having different concentration of ammonium formate and each sample was diluted with 50 ml water.

Table 5 shows freezing tests of the 6 diluted samples and the amount of ammonium formate present in the concentrated samples.

The 6 diluted samples with different concentrations of ammonium formate but the same concentration of alcohol (ethanol and ethylene glycol) were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 5: 820 mg ammonium acetate, 2.54 ml ethylene glycol, 6.98 ml ethanol

| Amount ammonium formate | Freezing point |
|---|---|
| 0 mg | -7.9 °C |
| 100 mg | -8.2 °C |
| 200 mg | -8.4 °C |
| 300 mg | -8.7 °C |
| 500 mg | -8.9 °C |
| 600 mg | -9.1 °C |

Table 5 shows that the freezing point of a solution comprising ammonium acetate alcohol and water (ratio 1:5) obtains an even lower freezing point if ammonium formate is added.

**Example 6 - Freezing tests of ethylene glycol in concentrate comprising fixed amount of ammonium formate, ammonium acetate and ethanol**

Freezing tests of samples comprising a different amount of ethylene glycol in a concentrate with a fixed amount of ammonium acetate, ammonium formate and ethanol have been performed.

Samples with 6.98 ml ethanol was prepared and 400 mg ammonium formate and 820 mg ammonium acetate was added. Different amounts of ethylene glycol was

added to the samples. 5 samples was prepared, each having different concentration of ethylene glycol and each sample was diluted with 50 ml water.

Table 6 shows freezing tests of the 5 diluted samples and the amount of ethylene glycol present in the concentrated samples.

The 5 diluted samples with different concentrations ethylene glycol but the same concentration of ammonium acetate, ammonium formate and ethanol were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 6: 400 mg ammonium formate, 820 mg ammonium acetate, 6.98 ml ethanol

| Amount ethylene glycol | Freezing point |
|---|---|
| 0 ml | -6.5 °C |
| 1 ml | -7.8 °C |
| 2 ml | -8.6 °C |
| 3 ml | -10.1 °C |
| 4 ml | -10.9 °C |

Table 6 shows that the freezing point of a solution comprising ammonium formate, ammonium acetate, ethanol and water (ratio 1:5 between concentrate and water) obtains an even lower freezing point if ethylene glycol is added.

**Example 7 - Freezing tests of ethanol in concentrate comprising fixed amount of ammonium formate, ammonium acetate and ethylene glycol**

Freezing tests of samples comprising a different amount of ethanol in a concentrate with a fixed amount of ammonium acetate, ammonium formate and ethylene glycol have been performed.

Samples with 2.54 ml ethylene glycol was prepared and 400 mg ammonium formate and 820 mg ammonium acetate was added. Different amounts of ethanol was added to the samples. 5 samples was prepared, each having different concentration of ethanol and each sample was diluted with 50 ml water.

Table 7 shows freezing tests of the 5 diluted samples and the amount of ethanol present in the concentrated samples.

The 5 diluted samples with different concentrations ethanol but the same concentration of ammonium acetate, ammonium formate and ethylene glycol were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 7: 400 mg ammonium formate, 820 mg ammonium acetate, 2.54 ml ethylene glycol

| Amount ethanol | Freezing point |
|---|---|
| 0 ml | -3.2 °C |
| 2 ml | -5.0 °C |
| 4 ml | -6.2 °C |
| 6 ml | -8.8 °C |
| 8 ml | -10.6 °C |

Table 7 shows that the freezing point of a solution comprising ammonium formate, ammonium acetate, ethylene glycol and water (ratio 1:5 between concentrate and water) obtains an even lower freezing point if ethanol is added.

**Example 8 – Freezing tests of ethanol with different salts**

Freezing tests of samples comprising different salts dissolved in either ethanol or water have been performed.

Samples with 10 ml of either water or ethanol was prepared and 400 mg of a salt (different salts) was added to the 10 ml samples. The samples was diluted with 50 ml water.

Table 8 and 9 shows freezing tests of the diluted samples and the amount of the salt present in the concentrated 10 ml samples.

The diluted samples were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 8: Different salts dissolved in 10 ml water

| Amount salt in 10 ml water | Freezing point |
|---|---|
| 400 mg ammonium formate | -0.2 °C |
| 400 mg ammonium acetate | -0.2 °C |
| 200 mg ammonium formate + 200 mg ammonium acetate | -0.3 °C |

Table 9: Different salts dissolved in 10 ml ethanol

| Amount salt in 10 ml ethanol | Freezing point |
|---|---|
| 400 mg ammonium formate | -8.7 °C |
| 400 mg ammonium acetate | -8.2 °C |
| 400 mg ammonium bicarbonate | -7.9 °C |
| 400 mg ammonium carbonate | -8.9 °C |

Table 8 shows that the freezing point of a solution of different salts dissolved in water will not change the freezing point significantly from the freezing point of water. However, as shown in table 9, when the salts are dissolved in ethanol, the freezing point will be lower than the freezing point of ethanol itself (freezing point of 10 ml ethanol diluted in 50 ml water is -7.2°C).

**Example 9 – precipitation test of different salts**

Precipitation tests have been made of different salts in order to see how the salt precipitate during storage.

Samples comprising 4 g salt dissolved in 20 ml water was prepared and stored for 24 hours whereafter the precipitation of samples were evaluated after a 1 to 5 scale where 5 is the best. "1" is given for samples which precipitate heavily within 5-6 hours, where "5" is given to samples where no precipitation is observed after 24 hours. "4" is given to samples having a slightly precipitation after 24 hours, where "3" were given to samples having more precipitaten and "2" to samples having even more precipitation after 24 hours.

Below in table 10 is the precipitation test of different salts dissolved in water shown.

Table 10: salt dissolved in 20 ml water, precipitation measured after 24 hours

| **Salt** | **Point** |
|---|---|
| Ammonium formate | 4 |
| Ammonium acetate | 4 |
| Ammonium bicarbonate | 3 |
| Ammonium carbonate | 3 |
| Ammonium chloride | 2 |
| Sodium formate | 2 |
| Sodium chloride | 1 |
| Gunidinium hydrochloride | 1 |
| Concentrate of 400 mg ammonium acetate and 820 mg ammonium formate in 6.98 ml of ethanol and 2.54 mg ethylene glycol (no water added) | 5 |

Thus, table 10 shows that the concentrate according to the present invention comprising ammonium formate or ammonium acetate will have a very low amount of precipitation after 24 hours while a concentrate comprising a combination of ammonium acetate and ammonium formate has no precipitation and has obtained the best score in the evaluation.

Table 10 also shows that even though some salts could be used as freezing point depressants (according to table 9), they dissolve pourly in water and will have much precipitates after 24 hours. Thus, these salts are not suitable for use in windshield washers, since it is wished not to have precipitates of the salts on the windows of the car.

In the above given precipitation test, the salts have been dissolved in water. If the salts instead would have been dissolved in alcohol, there would not be less precipitation, since the salts will only be less soluble in alcohol than in water.

**Example 10 – windshield washer concentrate**

Table 11 shows an example of a windshield washer concentrate according to the invention. The concentrate has a volume of 10 ml.

Table 11: 10 ml concentrate

| Compound | Amount |
|---|---|
| Ammonium formate | 400 mg |
| Ammonium acetate | 820 mg |
| Ethylene glycol | 2.54 ml |
| Ethanol | 6.98 ml |

**Example 11 – Freezing tests of ammonium formate, ethanol and ethylene glycol in different amounts**

Freezing tests of samples comprising a different amount of ammonium formate, ethanol and ethylene glycol have been performed.

11 samples was prepared, each having different concentration of ammonium formate, ethanol and ethylene glycol and each sample was diluted with 50 ml water before the freezing point was measured.

Table 12 shows freezing tests of the 11 diluted samples and the amount of ingredients present in the concentrated samples.

The 11 diluted samples with different concentrations of ammonium formate, ethanol and ethylene glycol were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 12: ammonium formate, ethanol and ethylene glycol in different amounts

| Concentration | Freezing point |
|---|---|
| 0.26 g NH4Formate + 1.2 ml ethylene glycol + 8.63 ml ethanol | -8.3 °C |
| 0.33 g NH4Formate + 0.89 ml ethylene glycol + 8.80 ml ethanol | -7.8 °C |
| 2.62 g NH4Formate + 7.04 ml ethylene glycol + 0.49 ml ethanol | -7.6 °C |
| 2.50 g NH4Formate + 6.69 ml ethylene glycol + 0.98 ml ethanol | -8.5 °C |
| 2.45 g NH4Formate + 6.52 ml ethylene glycol + 1.18 ml ethanol | -8.9 °C |
| 2.37 g NH4Formate + 6.30 ml ethylene glycol + 1.47 ml ethanol | -9.0 °C |
| 2.25 g NH4Formate + 5.93 ml ethylene glycol + 1.96 ml ethanol | -8.5 °C |
| 2.01 g NH4Formate + 5.19 ml ethylene glycol + 2.94 ml ethanol | -8.1°C |
| 1.52 g NH4Formate + 4.90 ml ethylene glycol + 3.70 ml ethanol | -8.6 °C |
| 1.03 g NH4Formate + 2.22 ml ethylene glycol + 6.86 ml ethanol | -8.0 °C |
| 0.54 g NH4Formate + 0.74 ml ethylene glycol + 8.82 ml ethanol | -8.4 °C |

NH4Formate refers to ammonium formate.

**Example 12 – Freezing tests of ammonium acetate, ethanol and ethylene glycol in different amounts**

Freezing tests of samples comprising a different amount of ammonium acetate, ethanol and ethylene glycol have been performed.

9 samples was prepared, each having different concentration of ammonium acetate, ethanol and ethylene glycol and each sample was diluted with 50 ml water before the freezing point was measured.

Table 13 shows freezing tests of the 9 diluted samples and the amount of ingredients present in the concentrated samples.
The 9 diluted samples with different concentrations of ammonium acetate, ethanol and ethylene glycol were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 13: ammonium acetate, ethanol and ethylene glycol in different amounts

| Concentration | Freezing point |
|---|---|
| 1.22 g NH4Acetate + 0.31 ml ethylene glycol + 8.64 ml ethanol | -7.4 °C |
| 1.35 g NH4Acetate + 0.63 ml ethylene glycol + 8.18 ml ethanol | -7.5 °C |
| 1.40 g NH4Acetate + 0.75 ml ethylene glycol + 8.00 ml ethanol | -8.2 °C |
| 1.48 g NH4Acetate + 0.94 ml ethylene glycol + 7.73 ml ethanol | -7.6 °C |
| 1.61 g NH4Acetate + 1.25 ml ethylene glycol + 7.27 ml ethanol | -7.4 °C |
| 1.87 g NH4Acetate + 1.88 ml ethylene glycol + 6.36 ml ethanol | -7.8 °C |
| 2.39 g NH4Acetate + 3.13 ml ethylene glycol + 4.54 ml ethanol | -7.9 °C |
| 2.91 g NH4Acetate + 4.58 ml ethylene glycol + 2.72 ml ethanol | -8.3°C |
| 3.43 g NH4Acetate + 5.53 ml ethylene glycol + 0.91 ml ethanol | -7.8 °C |

NH4Acetate refers to ammonium acetate.

**Example 13 – Freezing tests of ammonium formate, ammonium acetate, ethanol and ethylene glycol in different amounts**

Freezing tests of samples comprising a different amount of ammonium formate, ammonium acetate, ethanol and ethylene glycol have been performed.

40 samples was prepared, each having different concentration of ammonium formate, ammonium acetate, ethanol and ethylene glycol and each sample was diluted with 50 ml water before the freezing point was measured.

Table 14 shows freezing tests of the 40 diluted samples and the amount of ingredients present in the concentrated samples.
The 40 diluted samples with different concentrations of ammonium acetate, ethanol and ethylene glycol were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is

hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 14: ammonium formate, ethanol and ethylene glycol in different amounts

| Concentration | Freezing point |
|---|---|
| 0.21 g NH4Formate + 0.61 g NH4Acetate + 0.34 ml ethylene glycol + 8.20 ml ethanol | -8.6 °C |
| 0.25 g NH4Formate + 0.62 g NH4Acetate + 0.68 ml ethylene glycol + 8.55 ml ethanol | -8.3 °C |
| 0.27 g NH4Formate + 0.68 g NH4Acetate + 0.68 ml ethylene glycol + 8.50 ml ethanol | -8.7 °C |
| 0.29 g NH4Formate + 0.71 g NH4Acetate + 0.82 ml ethylene glycol + 8.31 ml ethanol | -8.1 °C |
| 0.18 g NH4Formate + 0.50 g NH4Acetate + 1.34 ml ethylene glycol + 8.09 ml ethanol | -8.0 °C |
| 0.23 g NH4Formate + 0.51 g NH4Acetate + 1.18 ml ethylene glycol + 8.17 ml ethanol | -8.2 °C |
| 0.24 g NH4Formate + 0.57 g NH4Acetate + 1.18 ml ethylene glycol + 8.11 ml ethanol | -8.3 °C |
| 0.30 g NH4Formate + 0.63 g NH4Acetate + 1.02 ml ethylene glycol + 8.14 ml ethanol | -8.2°C |
| 0.33 g NH4Formate + 0.74 g NH4Acetate + 1.02 ml ethylene glycol + 8.03 ml ethanol | -9.6 °C |
| 0.24 g NH4Formate + 0.57 g NH4Acetate + 1.68 ml ethylene glycol + 7.16 ml ethanol | -8.0 °C |
| 0.29 g NH4Formate + 0.63 g NH4Acetate + 1.52 ml ethylene glycol + 7.67 ml ethanol | -8.5°C |
| 0.31 g NH4Formate + 0.66 g NH4Acetate + 1.52 ml ethylene glycol + 7.61 ml ethanol | -8.5 °C |

| | |
|---|---|
| 0.50 g NH4Formate + 0.51 g NH4Acetate + 1.43 ml ethylene glycol + 7.69 ml ethanol | -8.6°C |
| 0.23 g NH4Formate + 0.88 g NH4Acetate + 1.30 ml ethylene glycol + 7.67 ml ethanol | -9.0°C |
| 0.36 g NH4Formate + 0.70 g NH4Acetate + 1.37 ml ethylene glycol + 7.67 ml ethanol | -9.0°C |
| 0.31 g NH4Formate + 0.66 g NH4Acetate + 1.52 ml ethylene glycol + 7.61 ml ethanol | .9.2°C |
| 0.39 g NH4Formate + 0.81 g NH4Acetate + 1.37 ml ethylene glycol + 7.56 ml ethanol | -8.3°C |
| 0.30 g NH4Formate + 0.63 g NH4Acetate + 2.02 ml ethylene glycol + 7.14 ml ethanol | -8.4°C |
| 0.36 g NH4Formate + 0.75 g NH4Acetate + 1.87 ml ethylene glycol + 7.61 ml ethanol | -8.6°C |
| 0.43 g NH4Formate + 0.79 g NH4Acetate + 1.70 ml ethylene glycol + 7.67 ml ethanol | -8.6 °C |
| 0.45 g NH4Formate + 0.84 g NH4Acetate + 1.71 ml ethylene glycol + 7.61 ml ethanol | -9.0 °C |
| 0.36 g NH4Formate + 0.70 g NH4Acetate + 2.37 ml ethylene glycol + 6.67 ml ethanol | -9.8 °C |
| 0.48 g NH4Formate + 0.83 g NH4Acetate + 2.05 ml ethylene glycol + 6.72 ml ethanol | -9.0 °C |
| 0.64 g NH4Formate + 0.59 g NH4Acetate + 2.11 ml ethylene glycol + 6.76 ml ethanol | -8.5 °C |
| 0.64 g NH4Formate + 0.69 g NH4Acetate + 2.11 ml ethylene glycol + 6.67 ml ethanol | -9.2 °C |
| 0.50 g NH4Formate + 0.88 g NH4Acetate + 2.05 ml ethylene glycol + 6.67 ml ethanol | -8.3 °C |
| 0.51 g NH4Formate + 0.93 g NH4Acetate + 2.05 ml ethylene glycol + 6.61 ml ethanol | -7.9 °C |
| 0.35 g NH4Formate + 0.64 g NH4Acetate + 2.87 ml ethylene glycol + 6.22 ml ethanol | -9.2 °C |
| 0.91 g NH4Formate + 0.48 g NH4Acetate + 2.85 ml ethylene glycol + 5.85 ml ethanol | -8.4 °C |

| | |
|---|---|
| 0.48 g NH4Formate + 0.83 g NH4Acetate + 3.06 ml ethylene glycol + 5.72 ml ethanol | -8.9 °C |
| 0.63 g NH4Formate + 0.59 g NH4Acetate + 3.11 ml ethylene glycol + 5.76 ml ethanol | -8.4 °C |
| 0.64 g NH4Formate + 1.06 g NH4Acetate + 2.73 ml ethylene glycol + 5.67 ml ethanol | -7.9 °C |
| 0.50 g NH4Formate + 0.88 g NH4Acetate + 3.05 ml ethylene glycol + 5.67 ml ethanol | -8.0 °C |
| 0.62 g NH4Formate + 1.01 g NH4Acetate + 2.73 ml ethylene glycol + 5.72 ml ethanol | -9.3 °C |
| 0.61 g NH4Formate + 0.96 g NH4Acetate + 3.73 ml ethylene glycol + 4.78 ml ethanol | -8.7 °C |
| 0.91 g NH4Formate + 0.48 g NH4Acetate + 3.85 ml ethylene glycol + 4.85 ml ethanol | -8.2 °C |
| 0.76 g NH4Formate + 1.19 g NH4Acetate + 3.41 ml ethylene glycol + 4.72 ml ethanol | -9.5 °C |
| 1.00 g NH4Formate + 1.45 g NH4Acetate + 4.78 ml ethylene glycol + 4.78 ml ethanol | -8.6 °C |
| 0.15 g NH4Formate + 2.15 g NH4Acetate + 6.90 ml ethylene glycol + 0.86 ml ethanol | -7.8 °C |

NH4Formate refers to ammonium formate.
NH4Acettae refers to ammonium acetate.

**Example 14 – Freezing tests of concentrate in different mixing ratios between concentrate and water**

Freezing tests of samples comprising a 400 mg ammonium formate, 820 mg ammonium acetate, 6.98 ml ethanol and 2.54 ml ethylene glycol have been performed, where the concentrate has been mixed with water in different ratios.

Table 15 shows freezing tests of the diluted samples.
The diluted samples were measured for their freezing point temperatures. The measurement was made by placing a thermometer in the samples, agitate and make a slow cooling of the samples. The temperature for the freezing point is

hereby measured according to the "*Standard Test Method for Freezing Point of Aqueous Engine Coolants – D1177-12*";

The temperature given are the temperature where the sample starts to either preticipitate or where the sample is either partly or fully frozen.

Table 15: freezing point af concentrate in diffentent ratios

| Ratio (concentrate:water) | Freezing point |
|---|---|
| 1:6.25 | -6.8 °C |
| 1:5.56 | -7.6 °C |
| 1:5 | -9.8 °C |
| 1:4 | -11.8 °C |
| 1:3.125 | -15.9 °C |
| 1:3 | -16.3 °C |
| 1:2.78 | -18.6 °C |
| 1:2.5 | -22.7 °C |
| 1:2 | -26.2 °C |
| 1:1 | -48.8 °C |
| 2:1 | -63.0 °C |
| 1:0 | -63.0 °C |

**Example 15 – Freezing tests of different alcohols**

In table 16 is shown the freezing point of different alcohols when they are mixed with water in a ratio of 1:5, i.e. 1 part alcohol and 5 parts water.

Table 16:

| **Concentrate** | **Freezing point (°C)** |
|---|---|
| Methanol | -9.7 |
| Ethanol | -7.2 |
| Ethylene glycol | -7.2 |
| Ethylene glycol + ethanol (1.2:8.8) | -7.7 |
| Diethylene glycol | -4.6 |
| Diethylen glycol + ethanol (3:7) | -7.2 |

| | |
|---|---|
| Propylene glycol | -5.6 |
| Propylene glycol + ethanol (3:7) | -7.1 |
| Glycerol | -4.8 |
| Glycerol + ethanol (3:7) | -7.2 |

From table 16, it is shown that the inventors of the present invention has found out that mixing two alcohols, such as for example ethanol and ethylene glycol, will result in a lower freezing point as compared to the two alcohols used alone.

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**Claims**

1. A windshield washer concentrate comprising a first compound and alcohol, wherein the first compound is ammonium acetate or ammonium formate or a combination thereof and wherein the concentrate comprises the first compound in an amount of at least 5 g per litre alcohol.

2. The windshield washer concentrate according to claim 1, wherein the first compound is a combination of ammonium acetate and ammonium formate.

3. The windshield washer concentrate according to any of the claims 1 to 2, wherein the alcohol is one or more alcohols selected from alcohols having from 1-5 carbon atoms.

4. The windshield washer concentrate according to any of the claims 1 to 3, wherein the alcohol is selected from the group consisting of methanol, ethanol, propanol, butanol, propylene glycol, 1,3-propanediol, ethylene glycol, diethylene glycol, glycerol or mixtures thereof.

5. The windshield washe concentrate according to any of the claims 1 to 4, wherein the alcohol is a combination of at least two alcohols.

6. The windshield washer concentrate according to any of the claims 1 to 5, wherein the alcohol is a mixture of ethanol and at least one other alcohol.

7. The windshield washer concentrate according claim 2, wherein the ratio between ammonium acetate and ammonium formate is in the range of 1:2 to 4:1.

8. The windshield washer concentrate accoding to any of the claims 1 to 7, wherein the windshield washer concentrate further comprises a soap.

9. The windshield washer concentrate according to any of the claims 1 to 8, wherein the windshield washer concentrate does not comprise water.

10. Use of the windshield washer concentrate according to any of the claims 1 to 9 for preparing a ready-to-use windshield washer solution, wherein the windshield washer concentrate is mixed with water.

11. Use according to claim 10, wherein the ratio between the wind shield washer concentrate and water is from 1:10 to 2:1.

12. A ready-to-use windshield washer solution comprising the windshield washer concentrate according to any of the claims 1 to 9 and water.

# INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2016/050171

A. CLASSIFICATION OF SUBJECT MATTER
INV. C11D7/12 C11D7/26
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C11D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

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| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 31 August 2016 | 07/09/2016 |

| Name and mailing address of the ISA/ | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040,<br>Fax: (+31-70) 340-3016 | Richards, Michael |

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# INTERNATIONAL SEARCH REPORT

International application No
PCT/DK2016/050171

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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